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Short communication

Toxoplasma gondii infection in domestic ducks, free-range and caged chickens in southern China

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ABSTRACT

Toxoplasma gondii is widely distributed in humans and other animals including domestic poultry throughout the world, but little is known of the prevalence of *T. gondii* in chickens and ducks in People's Republic of China. In the present study, antibodies to *T. gondii* were investigated in 349 domestic ducks (*Anas* spp.), 361 free-range, and 244 caged chickens (*Gallus domesticus*) raised in commercial flocks in Southern China's Guangdong Province using the modified agglutination test (MAT). Antibodies to *T. gondii* (MAT titer of 1:5 or higher) were found in 56 (16%) of 349 ducks, 41 (11.4%) of 361 free-range, and 10 (4.1%) of 244 caged chickens. The results indicate soil contamination due to *T. gondii* oocysts because free-range chickens feed from the ground, and suggest that the meat from the domestic poultry may be an important source for human infection by *T. gondii* in People's Republic of China.

1. Introduction

Infection by the protozoan parasite *Toxoplasma gondii* is widely prevalent in humans and animals worldwide (Dubey and Beattie, 1988). A recent paper reviewed worldwide reports of clinical toxoplasmosis in experimentally and naturally infected chickens and concluded that clinical toxoplasmosis is rare in chickens (Dubey, in press). Free-range (FR) chickens are considered an important indicator of soil contamination with the environmentally resistant oocysts of *T. gondii* (Ruiz and Frenkel, 1980). FR chickens are also an important source of *T. gondii* infection for cats, and cats can shed millions of oocysts after eating *T. gondii*-infected tissues. Poultry meat is an important source of infection for humans. Dubey (in press) summarized worldwide prevalence of *T. gondii* infection in FR chickens and commercial poultry but this review included little information concerning the prevalence of *T. gondii* infection in chickens from People's Republic of China (PRC) because such information is published locally in PRC journals and not easily available to foreigners. In the present article we summarize *T. gondii* prevalence in birds (chickens and ducks) from PRC (Table 1). It is clear from data in Table 1 that most of these surveys were conducted many years ago and poultry management is constantly changing. We also document *T. gondii* seroprevalence in ducks and chickens from the southern part of PRC.

2. Material and methods

2.1. Naturally infected ducks and chickens

Serum samples were obtained from 349 domestic ducks slaughtered for meat during December, 2008 at an avian

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Table 1
The prevalence of *T. gondii* infection in domestic ducks and chickens in People's Republic of China.

Birds	Provinces/cities (location on map)	No. tested	Positive (%)	Serologic test[a]	Cut-off value	Time tested (year)	References
Chickens	Liaoning (LN)	308[b]	34.7	ELISA	0.3[c]	Unknown	Zhu et al. (2008)
(*Gallus domesticus*)	and Jilin (JL)	210[d]	2.8				
	Jiangsu (JS)	88	34.09	IHA	1:64	Unknown	Zhai et al. (1987)
	Henan (HN)	173	6.36	IHA	1:64	1988–1989	Wang and Ning (1992)
	Shandong (SD)	41	17.07	IHA	1:64	1997	Li et al. (2000)
	Shanghai (SH)	41	2.4	MAT	1:20	Unknown	Zhang et al. (2000)
	Xinjiang (XJ)	377	0.53	IHA	1:64	1989–1993	Wang et al. (1994)
	Qinghai (QH)	66	10.6	IHA	1:64	Unknown	Chen (2008)
	Shandong (SD)	503	2.98	IHA	1:64	1985–1987	Zhang et al. (1989)
	Shandong (SD)	100	2.0	IHA	1:64	Unknown	Zhao et al. (1995)
	Six provinces	1450	16.90	IHA	1:64	1986–1988	Lv (1993)
	Shanghai (SH)	106	0	IHA	1:64	1980–1982	Yu et al. (1985)
Ducks (*Anas* spp.)	Shandong (SD)	60	23.33	IHA	1:64	1985–1987	Zhang et al. (1989)
	Seven provinces	2341	3.93	IHA	1:64	1986–1988	Lv (1993)
	Jiangsu (JS)	115	32.17	IHA	1:64	Unknown	Zhai et al. (1987)
	Jilin (JL)	30	20.0	IHA	1:64	1984	Chen et al. (1986)
	Shanghai (SH)	57	0	IHA	1:64	1980–1982	Yu et al. (1985)

[a] ELISA: enzyme-linked immunosorbent assay, MAT: modified agglutination test, IHA: indirect hemagglutination test.
[b] Free-range chickens, type not specified by others.
[c] OD value.
[d] Caged chickens, type not specified by others.

market in Guangzhou City—the capital of Guangdong Province. These ducks were two–three-month old, and came from commercial farms locating in the suburb of Fosan City, Qingyuan City, Huadu District of Guangzhou City, Guangdong Province. The ducks were housed on the ground and had open access to commercial poultry feed with coccidiostats and water. The epidemiologic data was obtained via personal interviews with the workers on these farms.

Serum samples from 361 FR chickens were collected in two slaughterhouses in Guangzhou City that catered exclusively for chickens from commercial farms in Guangdong Province, Hainan Province, Hunan Province and Guangxi Zhuang Autonomous Region (Fig. 1). All chickens from a given locality were slaughtered at one facility. All FR chickens were approximately six-month old, raised on ground with the maximum density of 1 chickens/m^2, and had free access to feed and water. Serum samples

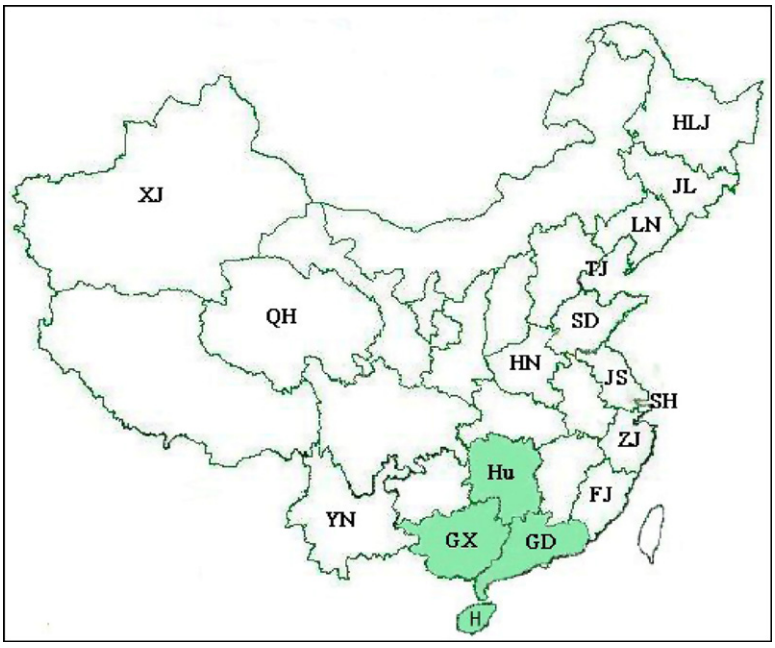

Fig. 1. The provinces/municipalities in Mainland China where chickens and ducks have been surveyed for *T. gondii*. Shadowed areas are the sampling locations for the present survey. H: Hainan Province; GD: Guangdong Province; GX: Guangxi Zhuang Nationality Autonomous Region; Hu: Hunan province; LN: Liaoning Province; JL: Jilin Province; JS: Jiangsu Province; SD: Shandong Province; SH: Shanghai Municipality; XJ: Xinjiang Uygur Autonomous Region; QH: Qinghai Province; FJ: Fujian Province; ZJ: Zhejiang Province; HLJ: Heilongjiang Province; YN: Yunnan; TJ: Tianjing Municipality.

Table 2
Seroprevalence of *T. gondii* in poultry in southern China in the present study.

Species	No. tested	No. of sera with MAT titers of:						% Positive	
		1:5	1:10	1:20	1:40	1:80	1:160	≧1:5	≧1:40
Ducks	349	22	18	10	3	2	1	16.0	1.7
Free-range chickens	361	12	8	12	7	1	1	11.4	2.5
Caged chickens	244	4	3	3	0	0	0	4.1	0

were also obtained from 244 caged chickens of 45–60 day old from four commercial flock areas around Guangzhou City during December, 2008.

2.2. Serological examination

Sera from chickens and ducks were diluted two-fold up to 1:640, starting at 1:5 and tested for *T. gondii* antibodies with the modified agglutination test (MAT) as described previously (Dubey and Desmonts, 1987). Briefly, whole killed *T. gondii* tachyzoites were used as antigen and serum samples were treated with 0.2 M 2-mercapthetanol to destroy the non-immunoglobulin (Ig)M antibody. The MAT has been evaluated extensively in experimentally (Dubey et al., 1993) and naturally infected chickens (Dubey, in press) and is considered specific for assaying *T. gondii* antibodies in animals. Positive and negative controls were included in each test. Those samples with doubtful results were re-tested.

3. Results and discussion

Antibodies to *T. gondii* were found in 16% of ducks, 11.4% FR chickens, and 4.1% of caged chickens, but most had low titers (Table 2). The MAT titer that should be considered specific for the diagnosis of toxoplasmosis in poultry has not been determined (Dubey, in press). Although for most serological surveys a MAT titer of 1:25 is used as the cut-off, occasionally, *T. gondii* was isolated from chickens with a MAT titer of only 1:5 (Dubey et al., 2004; Dubey, in press). Therefore, we stated all titers in Table 2. The serological diagnosis of *T. gondii* in poultry is uncertain because certain serological tests (e.g. the Sabin Feldman dye test) do not work with avian species, and none of the serological tests have been validated for the diagnosis of avian toxoplasmosis, using isolation of the parasite as a guide. The most data on isolation of viable *T. gondii* are available with the MAT (reviewed in Dubey, in press).

It is difficult to compare results of the present study with other surveys in PRC because of different serological tests used, chickens surveyed from different sources, and samples from different regions of PRC (Table 1). Most surveys used the IHA test which is a very insensitive test for avian toxoplasmosis (Dubey et al., 1993). One survey used ELISA, but ELISA test in poultry needs higher salt concentrations than for mammalian sera (Dubey et al., 1993; Zhu et al., 2008). Additionally, many surveys in PRC were conducted many years ago and the management of birds is constantly changing, and hygiene in general has improved after the epidemic of avian influenza in PRC. However, we have compared our results with others from PRC in Table 1.

Compared with chickens, little is known of the prevalence of *T. gondii* infection in domestic ducks. Dubey et al. (2003) reported MAT antibodies (titer 1:80) in 3 of 16 ducks from Egypt; viable *T. gondii* was isolated from 1 of the 3 seropositive ducks but not from the 13 seronegative ducks. Literak and Hejlicek (1993) isolated viable *T. gondii* from 12% of 184 *Anas platyrhynchus*, 12.5% of 8 *Anas ferina*, and 28% of 25 *Aythya fuligula* caught in wild in Czec Republic.

The results we obtained indicated soil contamination due to *T. gondii* oocysts because free-range chickens feed from the ground, and suggested that the meat from the poultry might be an important source for human infection by *T. gondii*.

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